

# HOMEWORK 1

## UNITS AND VECTORS

$$1. \begin{aligned} V_x &= 19.70 \text{ m/s} \\ V_y &= -15.60 \text{ m/s} \\ |V| &= \sqrt{V_x^2 + V_y^2} = \sqrt{19.70^2 + (-15.60)^2} \\ &= 25.12866 \approx 25.13 \dots (B) \end{aligned}$$

$$2. \begin{aligned} \tan \theta &= \frac{Y\text{-Component}}{X\text{-Component}} \\ &= \frac{-15.6}{19.7} = -0.7918 \\ \therefore \theta &= -38.37^\circ (C) \end{aligned}$$

$$3. \begin{aligned} \text{Vector } A &= (x, y) = r(\cos \theta, \sin \theta) \\ &= 48.9(\cos -19.6, \sin -19.6) \\ B &= 73.6(\cos 50.8, \sin 50.8) \\ A &= (46.6, -14.82) \\ B &= (29.65, 52.69) \\ \vec{C} &= \vec{A} + \vec{B} = (46.6, -14.82) + (29.65, 52.69) \\ &= (76.25, 37.87) \\ |\vec{C}| &= \sqrt{76.25^2 + 37.87^2} = 84.1 \times 10^2 (A) \end{aligned}$$

$$4. \sin \theta = \frac{y}{r}$$

5. Time is not vector quantity (B)

6. Force is a vector quantity

(A) True

7. Length is not a vector quantity.

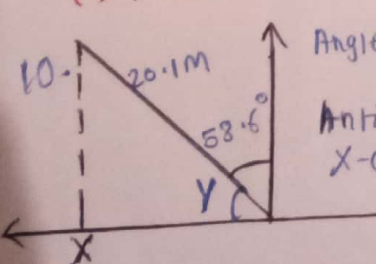
(B) False

8. Speed is not a vector quantity.

(B) False

9. Volume is not a vector quantity.

(B) False



Angle  $\gamma = 90^\circ - 58.6^\circ = 31.4^\circ$   
 Anti-clockwise  $= -31.4^\circ$   
 X-Component  $\Rightarrow \frac{\cos \gamma}{20.1}$   
 $X = \frac{\cos 31.4}{20.1}$   
 $X = -17.156$   
 $\approx -1.72 \times 10^1$   
 (C)

$$11. \sin \theta = \frac{\text{opp}}{\text{hyp}} \quad Y\text{-Component} = 10.4722$$

$$\sin 31.4 = \frac{Y\text{-Component}}{20.1} \approx 1.05 \times 10^1 \text{ choice (E)}$$

12. ~~B (False)~~ A (True)

13. A (True)

14. B (False)

15. A (True)

16. B (False)

17. A (True)

18. B (False)

19. B (False)

20. A (True)

21. A (True)

22. B (False)

$$23. 1 \text{ hour} = 60 \text{ minutes} = 3600 \text{ sec}$$

$$\therefore 1 \text{ hour} = 3600 \text{ sec}$$

$$1.5 \text{ hours} = ?$$

$$= 1.5 \times 3600 = 5400 \text{ sec}$$

$$= 5400 \text{ sec (E)}$$

$$24. 1 \text{ m}^3 = (100 \times 100 \times 100) \text{ cm}^3$$

$$= 1000000 \text{ cm}^3$$

$$\therefore 1150 \text{ m}^3 = (1150 \times 1000000) \text{ cm}^3$$

$$= 1.15 \times 10^9 \text{ cm}^3 (A)$$

$$25. 1 \text{ m}^3 = 35.3147 \text{ ft}^3$$

$$1150 \text{ m}^3 = ?$$

$$= (1150 \times 35.3147) \text{ ft}^3$$

$$= 40611.905$$

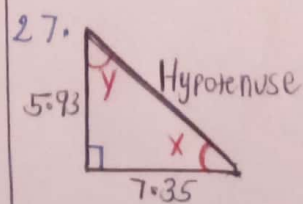
$$= 4.06 \times 10^4 \text{ ft}^3 (D)$$

$$26. 1 \text{ m}^3 = 61023.7 \text{ in}^3$$

$$1150 \text{ m}^3 = ?$$

$$= (1150 \times 61023.7) \text{ in}^3$$

$$= 7.02 \times 10^7 \text{ in}^3$$



$$H = \sqrt{5.93^2 + 7.35^2}$$

$$= 9.44 \text{ m (E)}$$

28

28. From the above triangle, the first angle is  $90^\circ$

Angle X

$$\tan X = \frac{5.93}{7.35} = 0.8068$$

$$\therefore X = 38.897^\circ$$

Angle Y

$$\tan Y = \frac{7.35}{5.93} = 1.2394$$

$$\therefore Y = 51.1033^\circ$$

Comparing the above angles, it is clear that the smallest angle is  $38.897^\circ$

$$\approx 3.89 \times 10^1 \text{ (B)}$$

29. Linear Scale Factor (L.S.F)  
 $= 2.60$

Area Scale Factor (A.S.F)  $= (\text{L.S.F})^2$

$$= (2.6)^2 = 6.76$$

$$= 6.76 \text{ (Choice D)}$$

# HOMEWORK, HW/2-10 MOTION

1. Initial speed,  $U$   
Final Speed,  $V$   
Acceleration,  $a$   
Time,  $t$ .

$$\text{Acceleration, } a = \frac{\text{Final Speed} - \text{Initial Speed}}{\text{Time}}$$

$$\Rightarrow a = \frac{V - U}{t}$$

$$U = 19.8 \text{ m/s}$$

$$\cancel{V = 10.9 \text{ m/s}}$$

$$V = 27.0 \text{ m/s}$$

$$t = 10.9 \text{ s}$$

$$a = \frac{27 - 19.8}{10.9}$$

$$= \frac{7.2}{10.9} \text{ m/s}^2$$

$$V^2 = U^2 + 2as$$

Where  $s$  is distance traveled.

Therefore,  $27^2 = 19.8^2 + (2 \times \frac{7.2}{10.9} \times s)$

$$729 = 392.04 + \frac{144s}{10.9}$$

$$336.96 = \frac{144s}{10.9}$$

$$\cancel{336.96} \times 10.9 = 144s$$

$$36728.64 = 144s$$

Therefore  $s = \frac{36728.64}{144}$

$$= 255.06 \text{ m}$$

$$\approx 2.55 \times 10^2 \text{ m}$$

(Choice E)

## 2. Acceleration

$$\Rightarrow a = \frac{V - U}{t} = \frac{27 - 19.8}{10.9}$$

$$= \frac{7.2}{10.9} = 0.66055$$

$$\approx 6.61 \times 10^{-1} \text{ m/s}^2$$

(Choice E)

3.  $U = 0 \text{ m/s}$   
 $V = 25.1 \text{ m/s}$   
 $t = 2.10 \text{ sec}$   
 $a = ??$

$$a = \frac{V - U}{t}$$

$$\Rightarrow \frac{25.1 - 0}{2.10}$$

$$= \frac{25.1}{2.1}$$

$$= 11.952 \text{ m/s}^2$$

$$\approx 12 \text{ m/s}^2$$

$$= 1.20 \times 10^1 \text{ m/s}^2$$

(Choice D)

## 4. Distance, $s$ .

$$V^2 = U^2 + 2as$$

$$25.1^2 = 0^2 + (2 \times 12 \times s)$$

$$630.01 = 24s$$

i.e,  $24s = 630.01$

Hence,  $s = \frac{630.01}{24}$

$$= 26.25 \text{ m}$$

$$\approx 2.64 \times 10^1 \text{ m}$$

(Choice E)

## 5. Acceleration

$U = 0 \text{ m/s}$   
 $V = 5.61 \text{ m/s}$   
 $t = 2.10 \text{ m/s}$   
 $a = ??$

$$a = \frac{V - U}{t}$$

$$= \frac{5.61 - 0}{2.1}$$

$$= \frac{5.61}{2.1} = 2.67 \text{ m/s}^2$$

$$= 2.67 \text{ m/s}^2$$

(Choice A)

## 6. Ratio of cheetah acceleration to that of the runner.

$$12 \text{ m/s}^2 : 2.67 \text{ m/s}^2$$

$$= \frac{12}{2.67} = 4.49$$

$$\approx 4.47 \text{ (Choice A)}$$

# HOMEWORK HW2 CONTINUED

## 7. Constant Acceleration

$$U = 55.7 \text{ m/s}$$

$$V = 0 \text{ m/s}$$

$$S = 1.24 \text{ km}$$

$$a = ??$$

$$V^2 = U^2 + 2aS$$

$$\text{NB } 1.24 \text{ km} = 1240 \text{ m}$$

$$0^2 = 55.7^2 + (2 \times 1240 \times a)$$

$$0^2 = 3102.49 + 2480a$$

$$-3102.49 = 2480a$$

$$\therefore a = \frac{-3102.49}{2480}$$

$$= -1.251 \text{ m/s}^2$$

The negative sign indicates this is a deceleration.  
Hence,  $a = 1.25 \text{ m/s}^2$

(Choice A)

## 8. Height

$$U = 0 \text{ m/s}$$

$$V = 27.4 \text{ m/s}$$

$$a = 9.8 \text{ m/s}^2$$

$$V^2 = U^2 + 2aS$$

Here,  $S$  represents height.

$$27.4^2 = 0^2 + (2 \times 9.8 \times S)$$

$$27.4^2 = 19.6S$$

$$750.76 = 19.6S$$

$$S = 38.30 \text{ m}$$

So the height required is

$$3.83 \times 10^1 \text{ m}$$

(Choice E)

## 9. Acceleration after the impact

$$U = 27.4 \text{ m/s}$$

$$V = 0 \text{ m/s}$$

$$t = 1.075 \text{ sec}$$

$$a = ??$$

$$a = \frac{V - U}{t}$$

$$\Rightarrow \frac{0 - 27.4}{1.07}$$

$$= -25.607 \text{ m/s}^2$$

Negative means deceleration

So the answer is  $2.56 \times 10^1 \text{ m/s}^2$   
(Choice E)

## 10. Change in Speed

$$U = 1.17 \text{ m/s}$$

$$a = 2.36 \text{ m/s}^2$$

$$t = \Delta t = (13.0 - 11.6) = 1.4 \text{ sec}$$

$$V = ??$$

$$a = \frac{V - U}{t} \Rightarrow 2.36 = \frac{V - 1.17}{1.4}$$

$$\Rightarrow 2.36 \times 1.4 = V - 1.17$$

$$3.304 = V - 1.17$$

$$V = 3.304 + 1.17$$

$$= 4.474 \text{ m/s}$$

$$\text{Change in Speed} = V - U$$

$$\Rightarrow 4.474 - 1.17$$

$$= 3.304$$

$$\approx 3.30 \text{ m/s}$$

(Choice E)

## 11. Speed at 13.0 sec

$$a = \frac{V - U}{t} \Rightarrow 2.36 = \frac{V - 1.17}{1.4}$$

$$3.304 = V - 1.17$$

$$\text{Therefore, } V = 3.304 + 1.17$$

$$= 4.474 \text{ m/s}$$

$$\approx 4.47 \text{ m/s}$$

(Choice B)

12. 12 A } The correct answer is  
12. B } 12. B is the object starts from rest and then accelerates in a positive direction.

12 C } The correct answer is  
12 D } 12 D

# HOMEWORK, HW 3-2D MOTION

- |              |               |
|--------------|---------------|
| 1. False (B) | 6. True (A)   |
| 2. True (A)  | 7. False (B)  |
| 3. False (B) | 8.            |
| 4. False (B) |               |
| 5. True (A)  | 9. False (B)  |
| 6. False (B) | 10. True (A)  |
| 7. False (B) | 11. False (B) |
| 8. True (A)  |               |

- |                                                            |                                                                      |
|------------------------------------------------------------|----------------------------------------------------------------------|
| 12. A. False<br>B. True<br>C. True<br>D. False<br>E. False | 13. True (A)<br>14.<br>15. True (A)<br>16. False (B)<br>17. True (A) |
|------------------------------------------------------------|----------------------------------------------------------------------|

18. Maximum height reached

$$H_{\text{max}} = \frac{U^2 \sin^2(\theta)}{2g}$$

$$= \frac{18.5^2 \times \sin^2 26.0}{2 \times 9.8}$$

$$h_{\text{max}} = y_0 + \frac{U^2 \sin^2 \theta}{2g}$$

$$= 1.02 + \frac{18.5^2 \sin^2 26.0}{2 \times 9.8}$$

$$\Rightarrow 1.02 + \frac{342.25 \sin^2 26.0}{19.6}$$

$$= 4.38 \text{ m}$$

19. Velocity on X-axis

$$X\text{-velocity} = 18.5 \cos 26$$

$$= 16.97846$$

$$\approx 1.66 \times 10^1 \text{ m/s}$$

(B)

20. Range =  $Ut$

We first calculate  $t$

$$S = Ut + \frac{1}{2}at^2$$

but  $Ut = 0$

Therefore,  $S = \frac{1}{2}at^2$

$$219 = \frac{1}{2} \times 9.8 \times t^2$$

$$219 = 4.9t^2$$

$$\therefore t = 6.6853 \text{ sec}$$

$$R = 68.6 \times 6.6853$$

$$= 458 \text{ m (choice B)}$$

21. Range,  $R = 24.4 \text{ m}$

$$V = 34.0 \text{ m/s}$$

$$R = \frac{V^2 \sin 2\theta}{g}$$

$$\therefore \sin 2\theta = \frac{Rg}{V^2}$$

$$= \frac{24.4 \times 9.8}{34^2}$$

$$\sin 2\theta = \frac{239.12}{1156}$$

$$= 0.20685$$

12 E } 12 E is correct  
13 A }

14. True (choice A)
15. False (choice B)
16. False (choice B)
17. False (choice B)
18. False (choice B)
19. True (choice A)
20. False (choice B)
21. False (choice B)
22. False (choice B)
23. True (choice A)

24. Height of a ball

$$U = 0 \text{ m/s}$$

$$t = 2.60 \text{ s}$$

$$a = 9.8 \text{ m/s}^2$$

$$S = \text{height}$$

$$S = Ut + \frac{1}{2}at^2$$

$$S = (0 \times t) + \left(\frac{1}{2} \times 9.8 \times 2.60^2\right)$$

$$S = 0 + 12.74$$

$$= 12.74 \text{ m}$$

$$S = 0 + 33.124$$

$$\text{Height} = 33.124$$

$$\approx 3.32 \times 10 \text{ m}$$

(choice C)

25 On moon's surface.

NB: The only difference is the moon's acceleration due to gravity.

$$a = 1.62 \text{ m/s}^2$$

$$U = 0 \text{ m/s}$$

$$t = ??$$

$$S = 33.2 \text{ m}$$

$$S = Ut + \frac{1}{2}at^2$$

$$33.2 = (0 \times t) + \left(\frac{1}{2} \times 1.62 \times t^2\right)$$

$$33.2 = 0.81 t^2$$

$$\therefore t^2 = \frac{33.2}{0.81} = 40.98765$$

$$t = \sqrt{40.98765}$$

$$= 6.402$$

$$\uparrow \approx 6.30 \text{ sec}$$

(choice B)

26. True (choice A)

27. True (choice A)

28. ~~False~~ True (choice A)

29. False (choice B)

30. False (choice B)

In case of any question  
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